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(71) Applicant: MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
1006, Oaza Kadoma
Kadoma-shi, Osaka-fu, 571(JP)

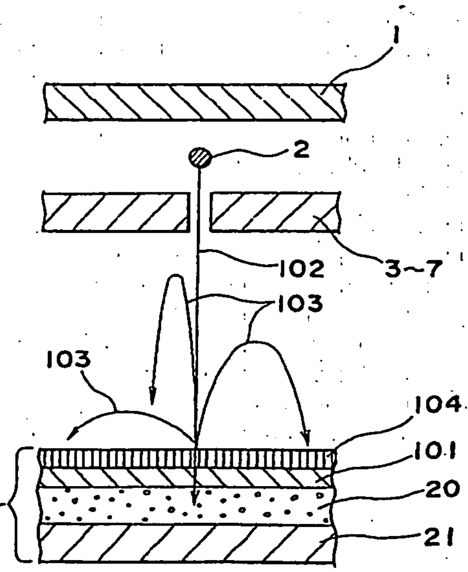
(72) Inventor: Otake, Keiichi
24-403, 6-banchi, Makita-cho
Takatsuki-shi, Osaka-fu(JP)
Inventor: Aikawa, Noboru
24-7, Yamatedai 3-chome
Ibaraki-shi, Osaka-fu(JP)
Inventor: Hosoki, Atsunori
8-26, Daigoshinkai, Fushimi-ku
Kyoto-shi, Kyoto-fu(JP)

(74) Representative: Eisenführ, Speiser & Strasse
Martinistrasse 24
W-2800 Bremen 1(DE)

(54) Image display element.

(57) In the image display element, where a cathode, and a control electrode for controlling the electron beams radiated from the cathode are provided within the vacuum cell, a phosphor layer which emits the light by the application of the electron beams, and a metal back layer which is positioned on the phosphor layer, is made of aluminum and brings the light emission of the phosphor to the front face by the mirror face effect are provided on the internal face of the face plate for constituting the vacuum cell, the present invention is characterized in that the carbon layer for reducing the generating of the rearward dispersed electrons is provided on the metal back layer, and the thickness of the aluminum is adjusted to reduce the rerush of the rearward dispersed electrons as much as possible.

Fig. 3



EP 0 446 878 A2

BACKGROUND OF THE INVENTION

The present invention generally relates to a cathode-ray tube for displaying the images by the application, upon the phosphor, of the electrons generated by the cathode within a vacuum cell, and more particularly, to an image display element using a cathode-ray tube which has a potential gradient within the vacuum cell.

Conventionally, although the Braun tube is mainly used as a display element for a color television image display use, it is impossible to make the conventional Braun tube thinner, because the depth thereof is much longer as compared with the size of the picture face.

As a plate-shaped display apparatus having the same light emitting principle as that of the Braun tube, the present applicant has been proposed a novel display apparatus of the USA patents Nos. 4,451,846 and USP 4,449,148.

This is a plate type image display apparatus which may fetch the electron beams from a plurality of linear thermal cathodes, may make the electron beams, controlled by an electron beam control electrode, collide against the fluorescent screen, and may display letters, images and so on.

The plate type image display apparatus is constructed as shown in Fig. 1. In Fig. 1, a back electrode 51 is adapted to direct into the front face direction the electron beams 72 to be emitted from a plurality of linear thermal cathodes shown in reference numerals 52a through reference numerals 52d. An electron beam fetching electrode 53 fetches the electrons by the linear thermal cathode 52a through 52d. Through holes 62 are provided in the electrode 53 to let the electron beams 72 pass through them. A signal electrode 54 which is provided to apply the video signals is composed of a plurality of control electrodes 64. The control electrode 64 has through holes 63 therein to let the electron beams 72 pass through it. A first focusing electrode 55 and a second focusing electrode 56 are provided to focus the electron beams 72 in the horizontal and vertical directions.

Through holes 64 and 65 are provided in the electrodes 55 and 56 to let the electron beams 72 to pass through them. A horizontal deflection electrode 68 deflects the electron beams in the right, left directions of the picture face, and is composed of one set of comb type of electrode 57a and 57b. The electrodes of the comb type of electrodes 57a and 57b constitute a slot 67 to let the electron beams 72 pass through with the mutual electrodes. A vertical deflection electrode 71 is provided to deflect the electron beams 72 in the vertical direction of the picture face, and is composed of a set of comb type of electrodes 58a and 58b. The comb type of electrodes 58a and 58b constitute a slot 70 with the mutual electrodes to let the electrode beams 72 to pass through it. A face plate (surface glass cell) 60 has a screen 73 composed of a three color phosphor layer of red, green, blue, a black stripe layer provided among them, and a metal back layer provided behind them on the inner face thereof.

A metallic plate 61 made of a back cell, and the face plate 60 constitute a vacuum cell.

But in such a conventional display apparatus as described hereinabove, the rearward dispersed electrons to be generated by the electrons applied upon the metal back layer of the face plate 60 as the interior of the display element has the potential gradient, instead of equipotential like the conventional Braun tube, are applied again upon the face plate, thus resulting in the largest factor for lowering the contrast ratio.

The above described factors will be described hereinafter again with reference to the drawings.

Fig. 2 A, B are views showing the internal construction of the Braun tube and the present image display element of the conventional embodiment.

In the drawings, the portions which are not necessary for illustration are omitted. In the case of the Braun tube a, the electron beams 82 transmitted from the electron gun 81 are applied upon the metal back 84 positioned on the face 83. Approximately 80 % of the electron beams pass through the metal back 84 and becomes incident to the fluorescent screen applied upon the face 83 so as to emit the light.

But the electron beams 82 of approximately remaining 20 % are reflected on the metal back 84 and become the rearward dispersed electrons 85 so that they are absorbed by a funnel 86 and a shadow mask. This is because the interior of the funnel 86 is equipotential. Although the approximately 20 % of the electron beams 82 transmitted from the cathode within the electrode 88 becomes the rearward dispersed electrons 85 as in the Braun tube in the case of the present image display element B of the conventional embodiment, the high voltage of approximately 10KV is applied upon the above described metal back 84 with the electrode 88 being provided with respect to approximately 300V. The element has an electrode gradient therein. The rearward dispersed electrons 85 are applied again upon the metal back 84 on the face 83, and the fluorescent screen except for the place where the electron beams 82 become incident primarily emits the light, thus reducing the contrast ratio considerably. It is to be noted that the metal back 84 is composed of aluminum layer.

SUMMARY OF THE INVENTION

Accordingly, the present invention has been developed with a view to substantially eliminating the above discussed drawbacks inherent in the prior art, and has for its essential object to provide an improved image display element.

Another important object of the present invention is to provide an improved image display element which is adapted to prevent the reduction in the contrast ratio by the rearward dispersed electrode so as to display the distinct images of good contrast.

In accomplishing these and other objects, according to the present invention, the carbon layer are formed on the metal back layer on the face plate. The thickness of the metal back layer is adjusted, and the transmission ratio of the transmission factor of the rearward dispersed electrons to be generated at the rush time of the electronic beams is to be restrained at 30% or lower.

By the above described construction, an image display element is provided where the generation of the rearward dispersed electrons is reduced by approximately half, the light emission of the fluorescent screen except for the location where the electron beams become primarily incident is also reduced by half, the contrast ratio is improved twice.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of the present invention will become apparent from the following description taken in conjunction with the preferred embodiments thereof with reference to the accompanying drawings, in which;

Fig. 1 is an exploded perspective view showing the basic construction of an image display element;

Fig. 2 A, B are views showing the inner construction of a Braun tube and an image display element;

Fig. 3 is an approximately side sectional view of an image display element in one embodiment of the present invention;

Fig. 4 is a structural model showing one example of a carbon layer forming method;

Fig. 5 is a characteristic graph showing the generation factor of the rearward dispersed electrons with respect to the atomic numeral of a target to which the electron beams become incident;

Fig. 6 is a structural model view showing the other example of the carbon layer forming method; and

Fig. 7 is a graph showing the relationship of the electron energy against energy transmission factor with the thickness of the metal back being made parameters.

DETAILED DESCRIPTION OF THE INVENTION

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

One embodiment of the image display element of the present invention will be described hereinafter with reference to the drawings.

Fig. 3 is an approximately side sectional view of an image display element of the present invention. Fig. 4 is a structural model showing a forming method of a carbon layer. Fig. 5 is a graph showing the relationship of the generation factor (rearward dispersion coefficient) η of the rearward dispersed electrons with respect to the atomic number Z of an target to which the electron beams become incident.

In Fig. 3, reference numeral 1 is a back electrode equivalent to the back electrode 51 of Fig. 1, reference numeral 2 is a linear cathode equivalent to a linear cathode 52 of Fig. 1, reference numerals 3 through 7 are electrode blocks equivalent to a beam fetching electrode 53, a signal electrode 54, a focusing electrode 55, horizontal • vertical deflecting electrodes 57, 58 of Fig. 1, reference numeral 8 is a screen plate equivalent to a screen 73 of Fig. 1, the screen plate being composed of a glass plate 21, a phosphor 20 to be positioned on it, a metal back (aluminum layer) 101 provided on the phosphor 20, a carbon layer 104 provided on the metal back 101. Reference numeral 102 shows electron beams to be generated from the linear cathode 2, reference numeral 103 is a rearward dispersed electrons (secondary electrons).

As clear from Fig. 5, the rearward dispersed electrons 103 are 18% of the electron beams 102 to be incident in a case of aluminum (atomic number 13) to be normally used even in the metal back 101. The rearward dispersed electrons 103 become 9% of the electron beams 102 to become incident in the case of the carbon (atomic number 6). If the carbon layer 104 is formed on the metal back 101, the generation of the rearward dispersion electrons 103 may be prevented by half, and the contrast ratio may be improved twice.

Fig. 4 is a structural model of the carbon layer forming method. In the drawing, assume that the phosphor 20 and the metal back 101 are already formed on the internal face of the glass plate 21. Carbon liquid 11 with powdered carbon being dissolved in a solvent such as water, alcohol or the like is put into a sprayer 12, is sprayed onto the metal back 101 of the glass plate 21 so as to the carbon layer 104. Thereafter, it is burned at approximately 450° C and the face plate is completed as a whole. Here the thickness of the carbon layer 104 is adjusted by tho spraying time or the spray-

ing amount of the sprayer 12. When the carbon layer 104 is too thick, the passing ratio of the electron beams is lowered, thus reducing the brilliance. Therefore, the carbon layer of approximately 0.3 through 0.4 in the thermal absorption factor is formed this time.

Fig. 6 is a structural model of the carbon layer forming method in a second embodiment of the image display element of the present invention.

Assume that the phosphor 20 and the metal back 101 are already formed on the internal face of the glass plate 21. A sufficient amount of carbon powder 13 is prepared and a glass plate 21 is placed above it with the metal back 101 being directed downwards. Apply the high voltage with a high tension generator 14 being connected with the metal back 101, and the carbon layer 104 is formed on the metal back 101 by the electric evaporation. Thereafter, it is burned at approximately 450°C and the face plate may be completed as a whole.

When the carbon layer is formed by the electric evaporation, the more uniform carbon layer may be obtained than by the spraying in the first embodiment. When the high-tension voltage to be applied upon the metal back on the face is comparatively low (in a case 15KV or lower), the face where uneven brilliance is not caused may be formed.

A third embodiment of the present invention will be described hereinafter.

Silicon resin is provided in the thickness of 2 microns on the full face of the resin film of approximately several tens of microns as a mold releasing layer. The carbon film is formed with spraying, electric evaporating or the like on the mold releasing layer so as to obtain the carbon layer forming sheet. The carbon layer forming sheet is transferred under pressure adherence on the metal back layer on the face plate, is burned at approximately 450°C to complete the face plate as a whole.

By the formation of the carbon layer through the above described transferring operation, the carbon layer forming sheet may be kept prepared in advance. The pressure adherence transferring operation has only to be effected at the face plate completing step. The simplification of the step may be effected.

Although the carbon is used in the present embodiment, the equal effect may be obtained if the normal temperature solid material which is smaller at the atomic number than aluminum is used.

A method of setting the thickness of the metal back 101 will be described with reference to the drawings. Fig. 7 is a graph showing the relation of the electron incident energy to the energy transmission factor when the thickness of the metal back 101 is provided as parameters.

Assume that the metal back 101 is 1000Å in thickness with the electric potential of 10KV being applied upon it in Fig. 3. In this case, the electron beams 102 generated from the linear cathode 2 (potential OV) are accelerated by the potential gradient with respect to the metal back 101, and are applied upon the metal back with the incident energy of 10keV. When the target is aluminum, the incident 18% is dispersed rearwards as rearward dispersed electrons 103, and the energies of the rearward dispersed electrons 103 become approximately 6keV (approximately 60 % of the incident energies). The secondary electrons dispersed rearwards rushes into the metal back again by the energies of approximately 6keV by the above described potential gradient. When the thickness of the metal back 101 is 1000Å, the energy transmission factor of the incident electrons (10keV) is 92%, the energy transmission factor of the rearward dispersion electrons (6keV) is 64%. Therefore, it is undesirable that the brilliance is extremely high, the transmission factor of the rearward dispersed electrons is also high, and the contrast is deteriorated. Assume that the thickness of the metal back is made 2000Å, the energy transmission factors of the incident electrons, the rearward dispersed electrons are respectively 77%, 16%. When the thickness of the metal back 101 is made 1000Å → 2000Å, the energy transmission factor (which is proportional to brilliance) of the incident electrons becomes 92% - 77% and the brilliance is also lowered somewhat. But the energy transmission factor (proportional to halation) of the rearward dispersed electrons is reduced as extremely low as 64% → 16%. Therefore, the brilliance is satisfactory and the contrast is also extremely good. But when the thickness of the metal back increases extremely, the brilliance is lowered large, so that the proper thickness is demanded. By the experiment, it has been found out that the balancing is provided in the brilliance and the contrast if the energy transmission factor of the rearward dispersed electrons is 30% or lower. On the basis of it, the thickness is proper to be 2000Å or more and 3500Å or lower when the voltage of the metal back is 10KV. In the case of 9kV, it is proper to be 1500Å or more and 3000A or lower. In the case of 8KV, it is proper to be 1500Å or more and 2000Å or lower.

As described hereinabove, the halation may be considerably reduced within some brilliance reduction by the adjustment of the thickness.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be noted here that various changes and modifications will be apparent to those skilled in the art. Therefore, unless other-

wise such changes and modifications depart from the scope of the present invention, they should be construed as included therein.

Claims

1. An image display element comprising a vacuum envelope having a face plate and a back cell, a cathode disposed within the vacuum envelope, a control electrode for controlling the electron beams radiated from the cathode, a hosphor layer positioned on the face plate and adapted to emit the light by the application of the electron beams, a metal back layer positioned on the phosphor layer and adapted to bring the light emission of the phosphor to the front face by the mirror face effect, a carbon layer positioned on the metal back layer to reduce the generation of the rearward dispersed electrons.

2. An image display element described in accordance with the claim 1, where the formation of the carbon layer is effected on the electric evaporation.

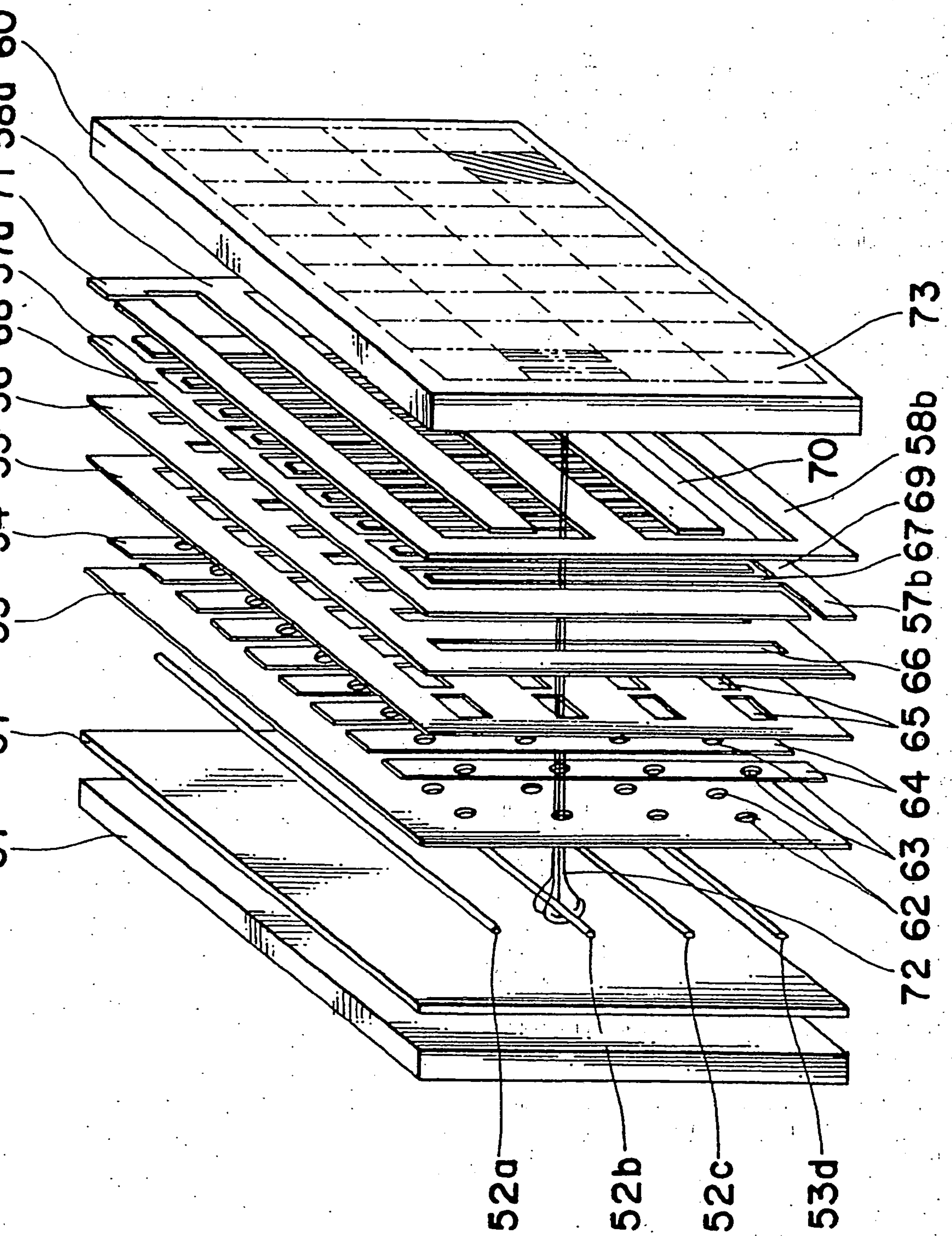
3. An image display element described in accordance with the claim 1, where the carbon layer formed sheet with the carbon film being formed on the mold releasing support member is transferred on the metal back layer on the face plate, the carbon layer is formed by the peeling off of the support member.

4. An image display element comprising a vacuum envelope having a face plate and a back cell, a cathode disposed within the vacuum envelope, a control electrode for controlling the electron beams radiated from the cathode, a phosphor layer positioned on the face plate and adapted to emit the light by the application of the electron beams, a metal back layer positioned on the phosphor layer and adapted to bring the light emission of the phosphor to the front face by the mirror face effect, the metal back layer is made of aluminum layer, with the thickness thereof being set to restrain the transmission factor of the rearward dispersed electron beams to be generated at the rush time of the electron beams at 30% or lower.

5. An image display element described in accordance with the claim 4, where the voltage of the metal back layer on the face plate is 10Kv, the thickness is 2000Å or more and 3500Å or lower.

6. An image display element described in accordance with the claim 4, where the voltage of the metal back layer on the face plate is 9KV, the thickness is 1500Å or more and 3000Å or lower.

7. An image display element described in accordance with the claim 4, where the voltage of the metal back layer on the face plate is 8KV, the thickness is 1500A or more and 2000Å or lower.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58a
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57a
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73
70
58b
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63
62
72
52a
52b
52c
53d

Fig. 1

Fig. 2(A)

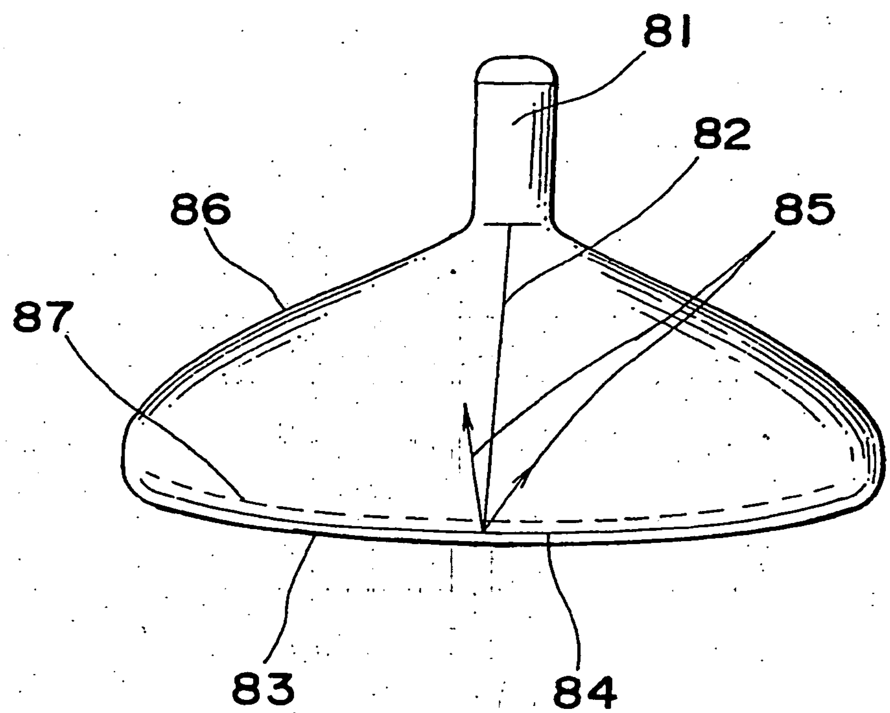


Fig. 2(B)

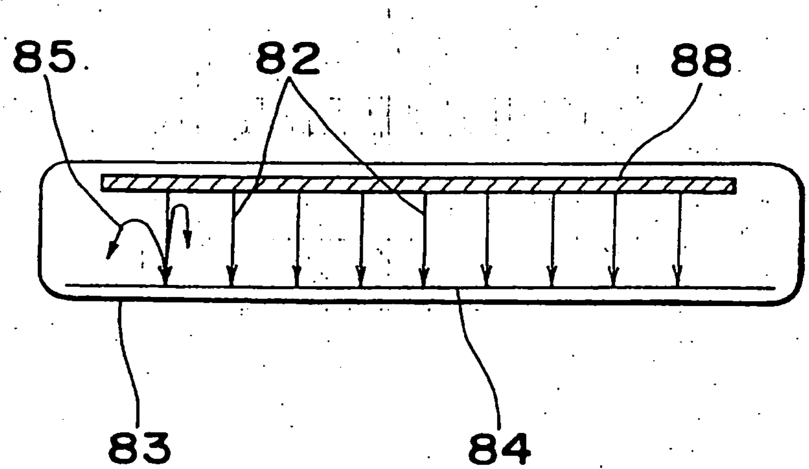


Fig. 3

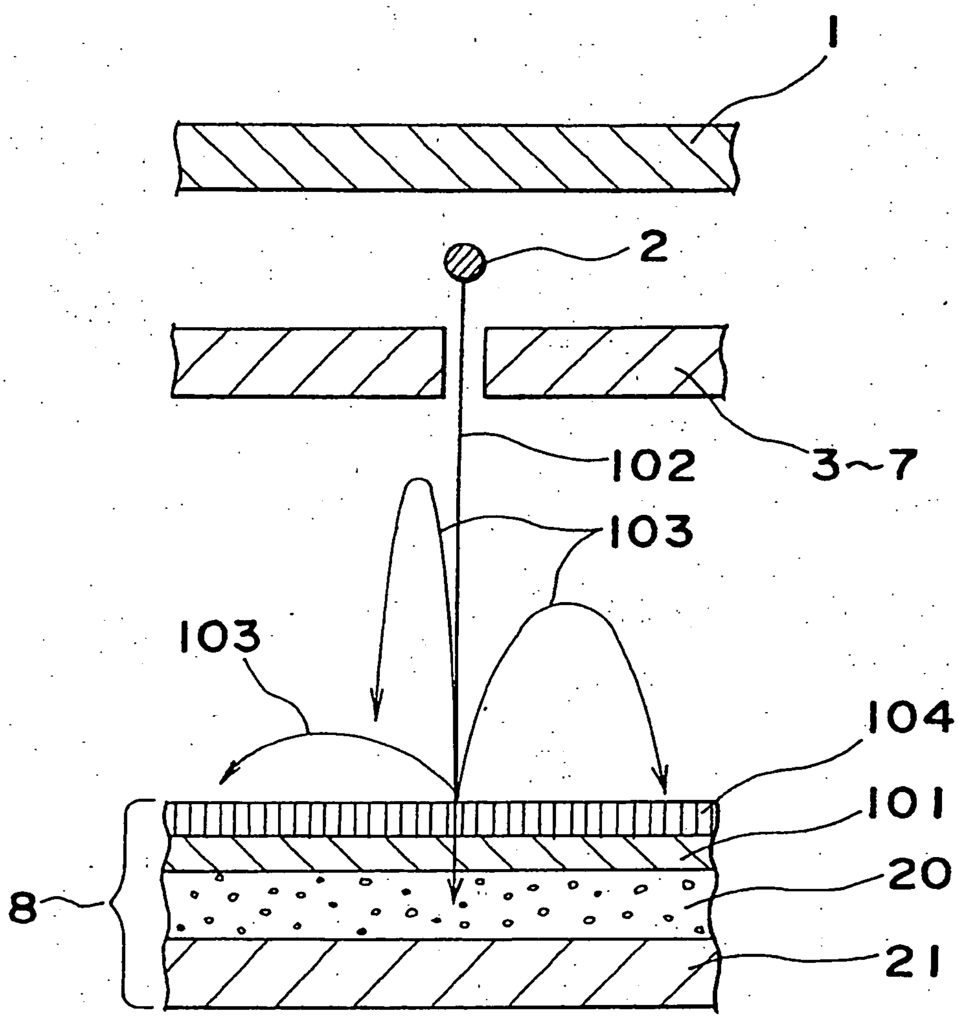


Fig. 4

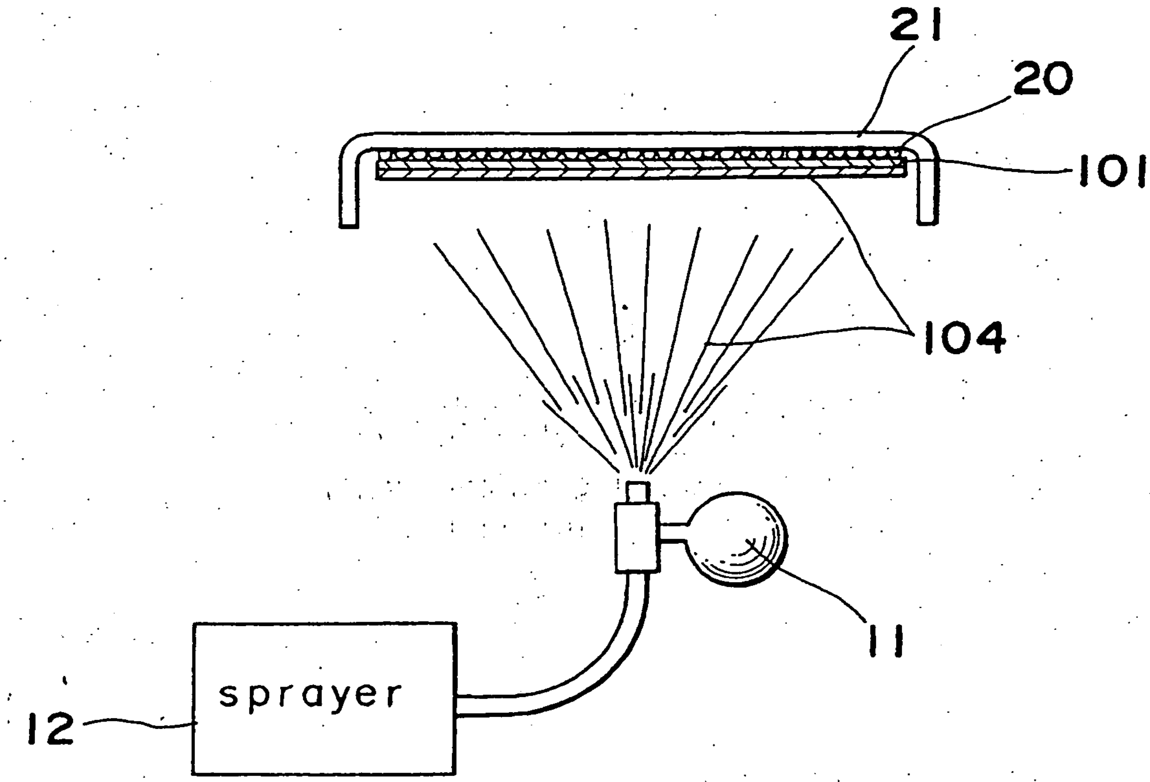

21
20
101
104
sprayer
12
11

Fig. 6

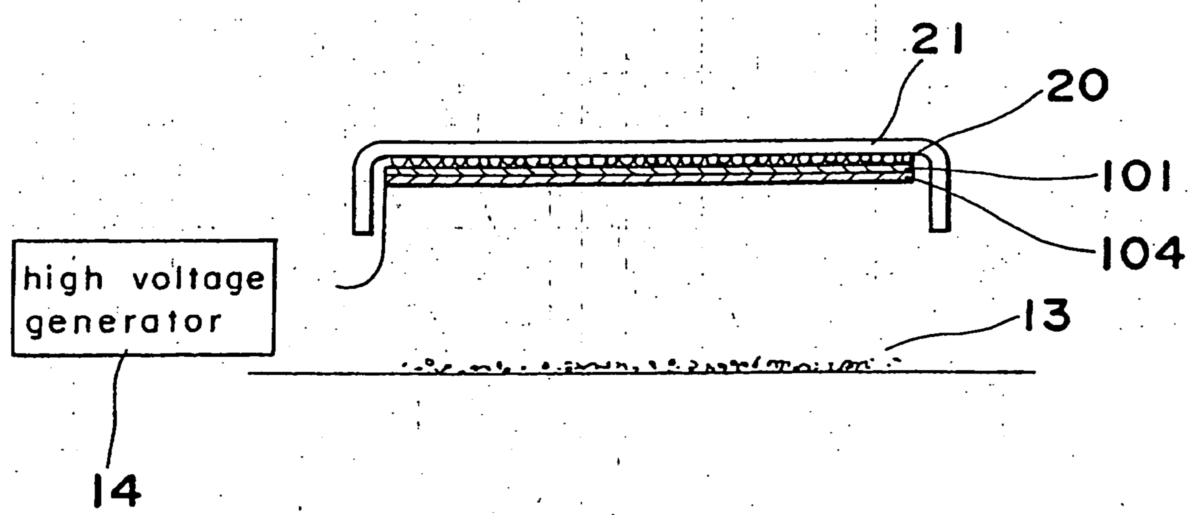
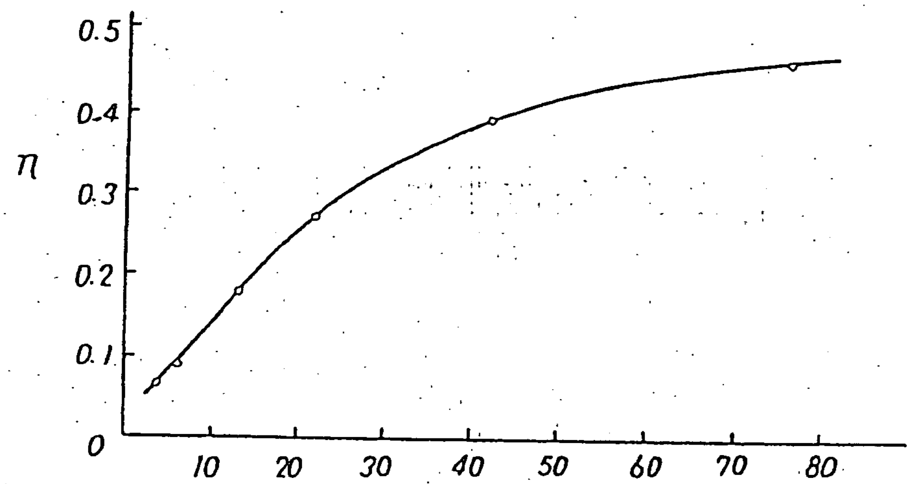

21
20
101
104
high voltage generator
13
14

Fig. 5



rearward scattering efficiency (η)
related to atom number (Z)

Fig. 7

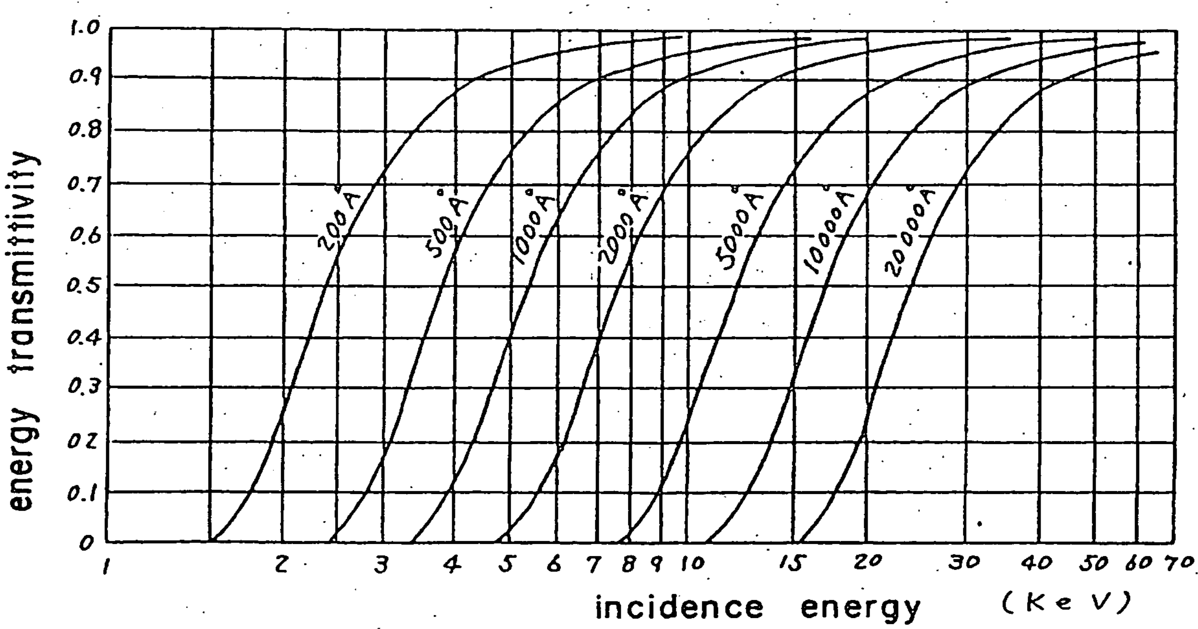
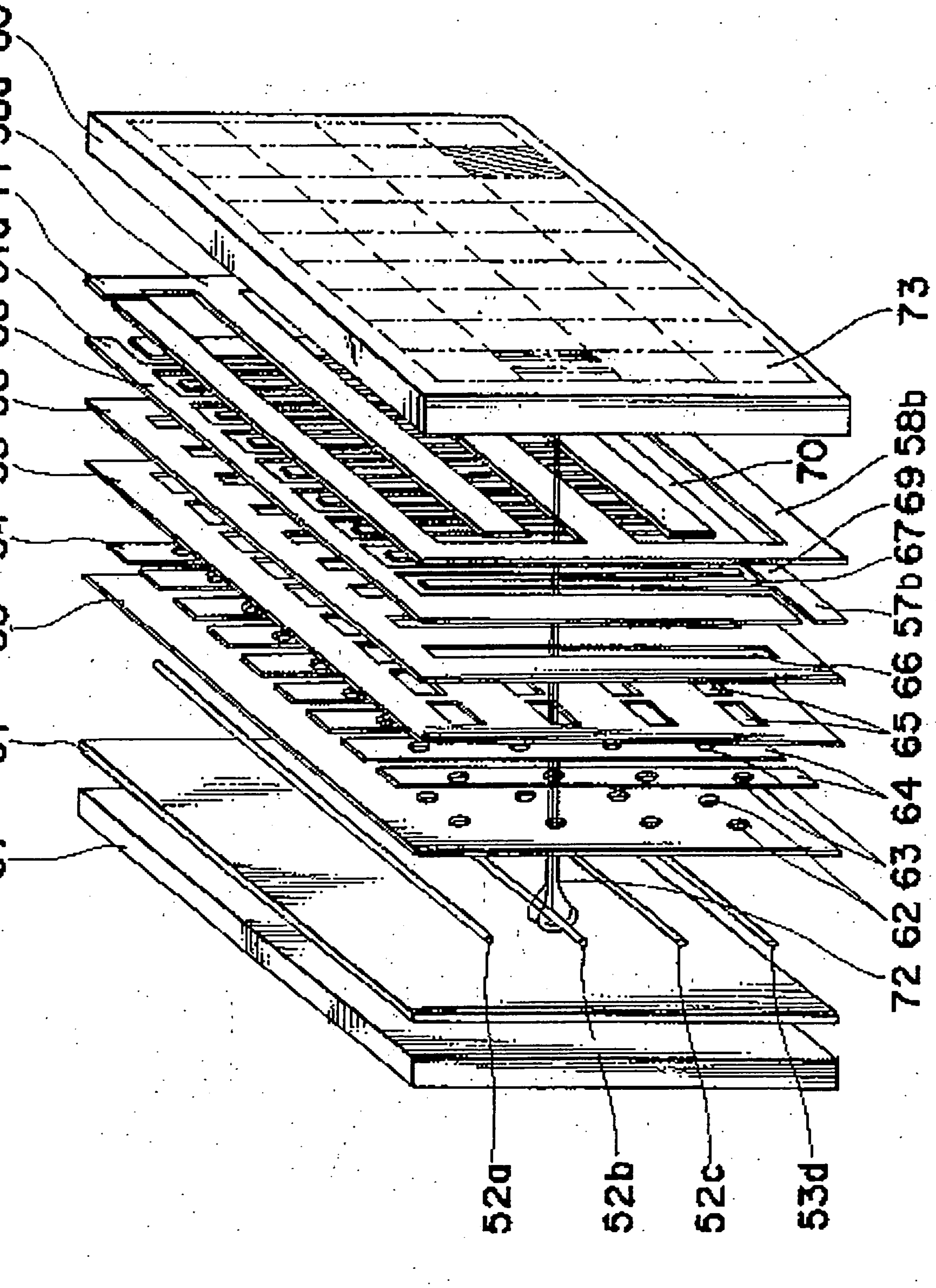


Fig. 1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57a
68
56
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53
51
61
73
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69
67
57b
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65
64
63
62
72
52a
52b
52c
53d

Fig. 2(A)

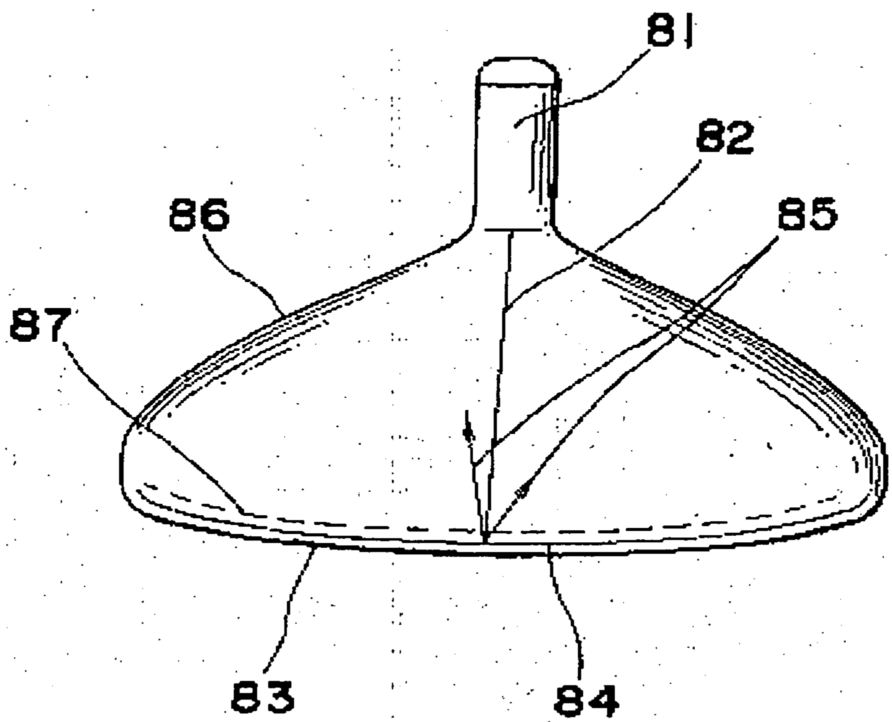


Fig. 2(B)

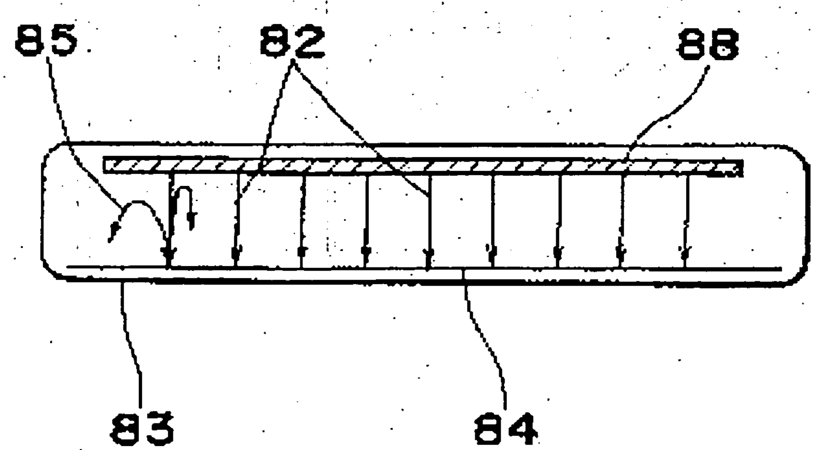


Fig. 3

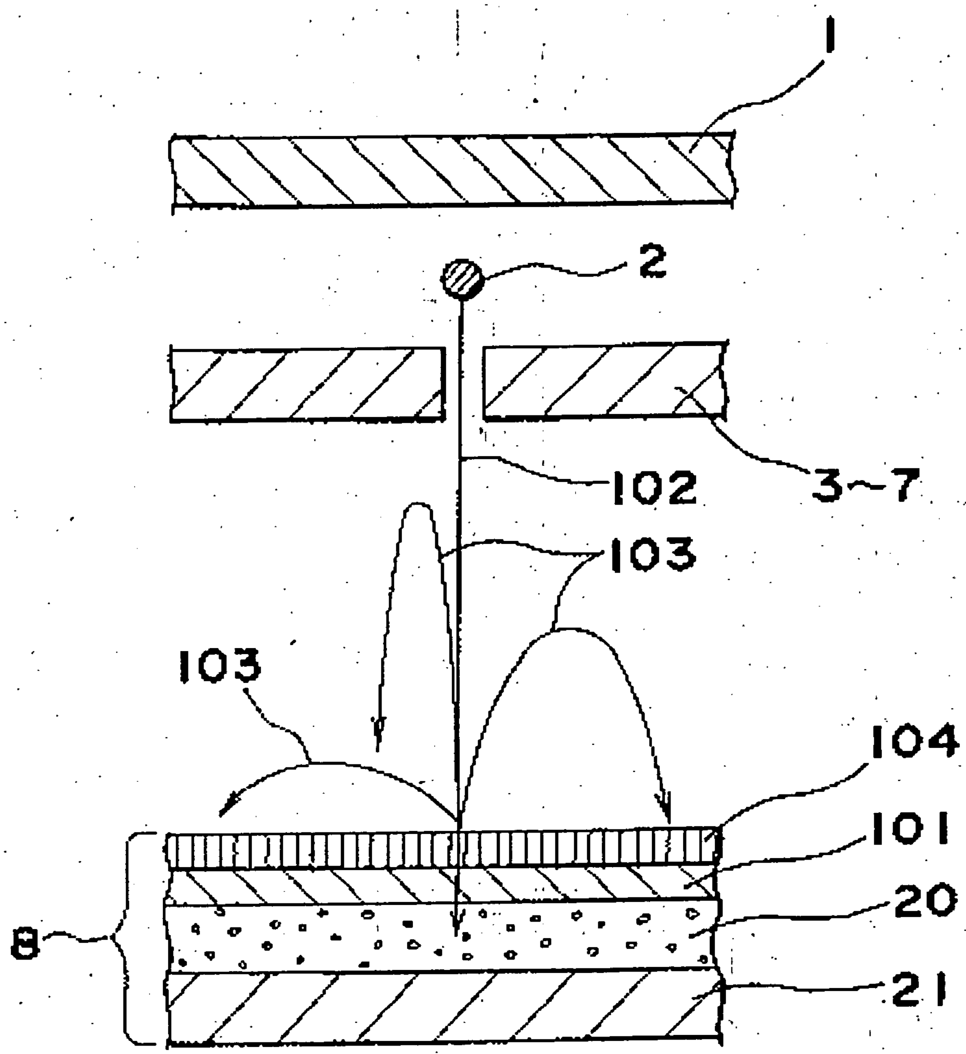
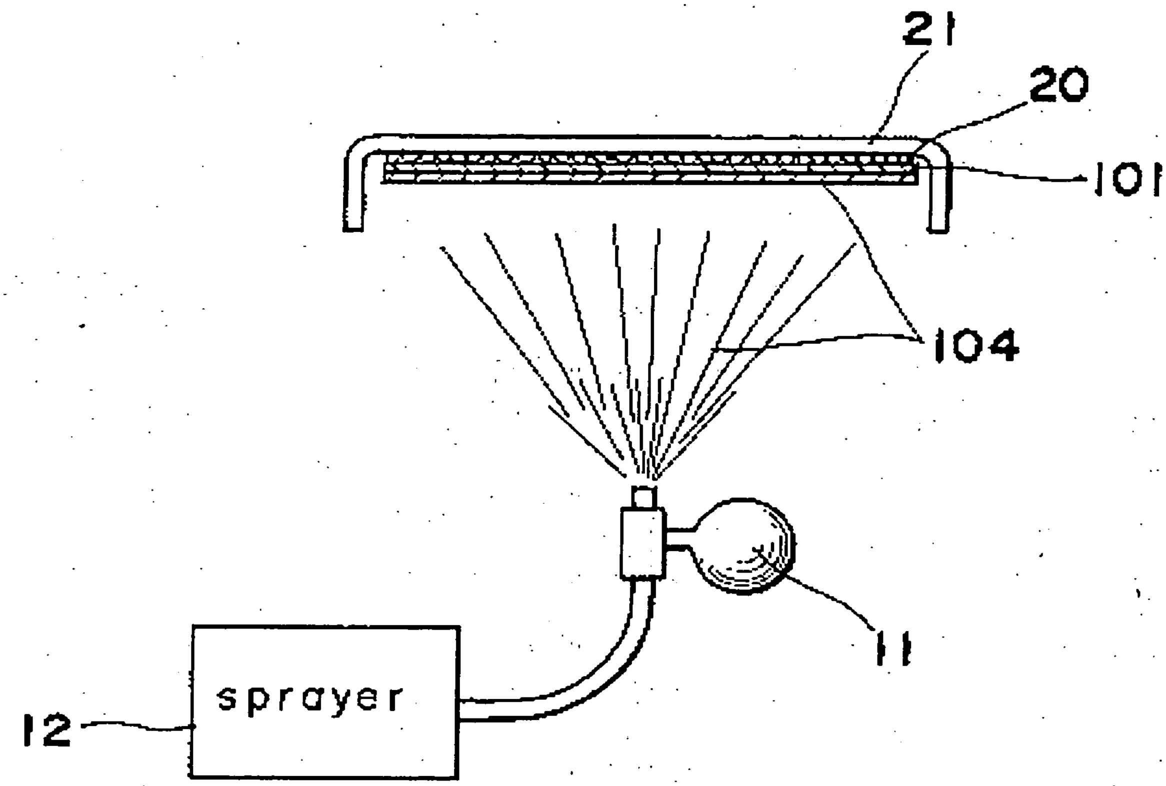


Fig. 4


21
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101
104
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sprayer
12

Fig. 6

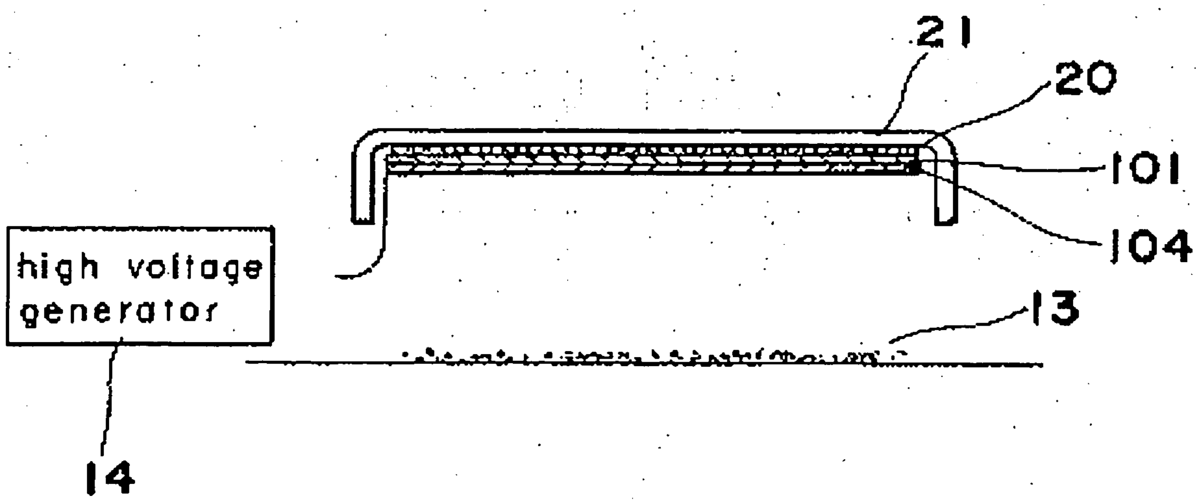
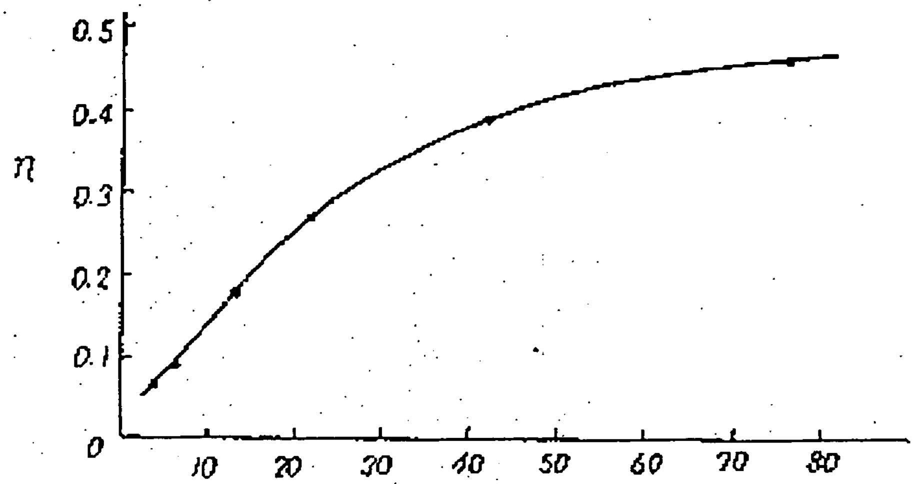
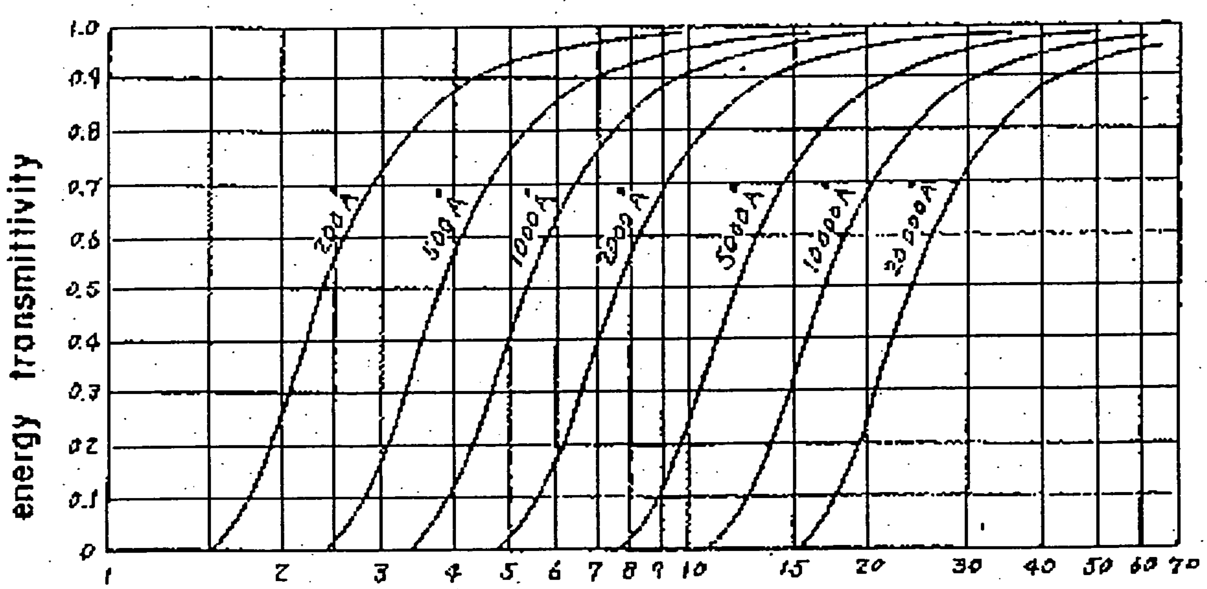

21
20
101
104
13
high voltage generator
14

Fig. 5



rearward scattering efficiency (η) related to atom number (Z)

Fig. 7



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(71) Applicant: MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
1006, Oaza Kadoma
Kadoma-shi, Osaka-fu, 571(JP)

(72) Inventor: Otake, Keiichi
24-403, 6-banchi, Makita-cho
Takatsuki-shi, Osaka-fu(JP)
Inventor: Aikawa, Noboru
24-7, Yamatedai 3-chome
Ibaraki-shi, Osaka-fu(JP)
Inventor: Hosoki, Atsunori
8-26, Daigoshinkai, Fushimi-ku
Kyoto-shi, Kyoto-fu(JP)

(74) Representative: Eisenführ, Speiser & Strasse
Martinistrasse 24
W-2800 Bremen 1(DE)

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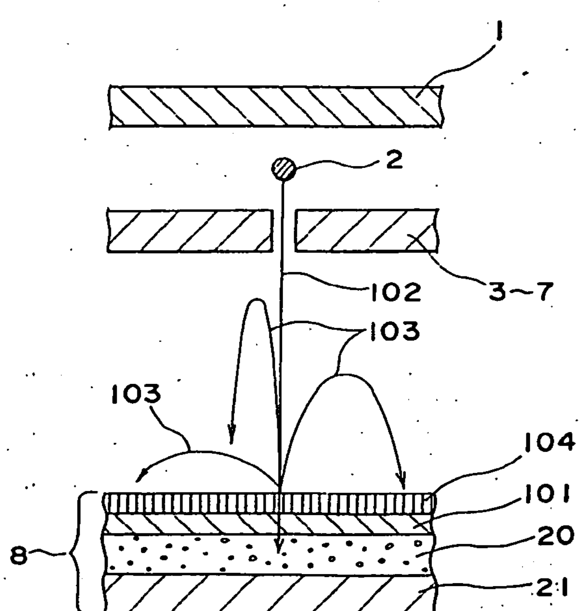
Fig. 3



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EUROPEAN SEARCH REPORT

Application Number

EP 91 10 3789

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A-2 120 840 (PHILIPS ELECTRONIC AND ASSOCIATED INDUSTRIES LIMITED) * page 1, line 8 - line 47 * * * page 2, line 19 - line 29 * * * claims * * * figure 2 * *	1-4	H 01 J 29/28
X	DE-A-2 164 174 (RCA CORPORATION) * page 2, paragraph 3 - page 3, paragraph 2 * * * claims 1,3-7 * *	1	
A	DE-A-1 281 588 (SONY CORPORATION) * the whole document * *	4-7	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
H 01 J

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	08 January 92	VAN DER POEL W.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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L: document cited for other reasons

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